(12) UK Patent Application (19) GB (11) 2 170 447 A

(43) Application published 6 Aug 1986

(21) Application No 8524033

(22) Date of filing 30 Sep 1985

(30) Priority data

(31) 698231 (32) 4 Feb 1985 (33) US

(51) INT CL⁴
B41F 33/02 13/12

(52) Domestic classification (Edition H):
B6C104 1200 1237 WB

(56) Documents cited
WO A 83/04219

(58) Field of search
B6C
Selected US specifications from IPC sub-class B41F

(71) Applicant
Ebway Industries Inc (USA-Illinois),
1111 Old Rand Road, Wauconda, Illinois 60084, United States of America

(72) Inventors
Thomas F. Curran,
Robert M. Schildgen

(74) Agent and/or Address for Service
Eric Potter & Clarkson, 14 Oxford Street, Nottingham NG1 5BP

(54) Register control for printing presses

(57) A remote-controlled register adjustment apparatus is provided for printing presses having a number of units, the printing cylinders being depicted in a graphic display (22) on a console, which display enables the operator to select the axial or circumferential corrections needed by pushing an appropriate touch-responsive device (26a to 49a). The correction is provided by synchronous motors which are fed by alternating current for a time interval that is calibrated with the correction amount. There may be a plurality of console stations with a communication line between console stations comprising a simple 75 ohm TV grade coaxial cable. The circuitry may have bidirectional characteristics to enable various functions to be independent of each other. A deliberate motor stall circuit is provided for centering the cylinders, the stall being created by bringing a cylinder to the end of its travel in one direction so that the motor can then be reversed for a pre-determined time to establish the centre position.

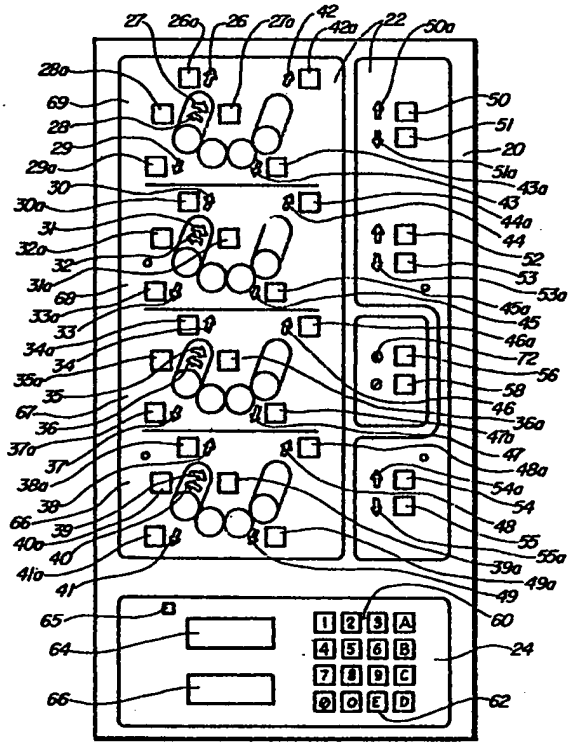


FIG. 2

GB 2 170 447 A

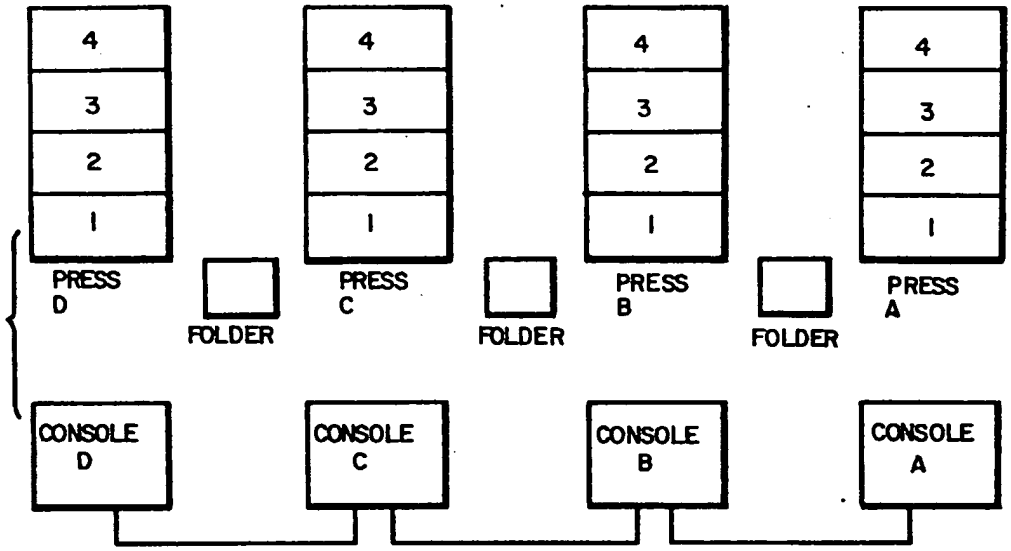
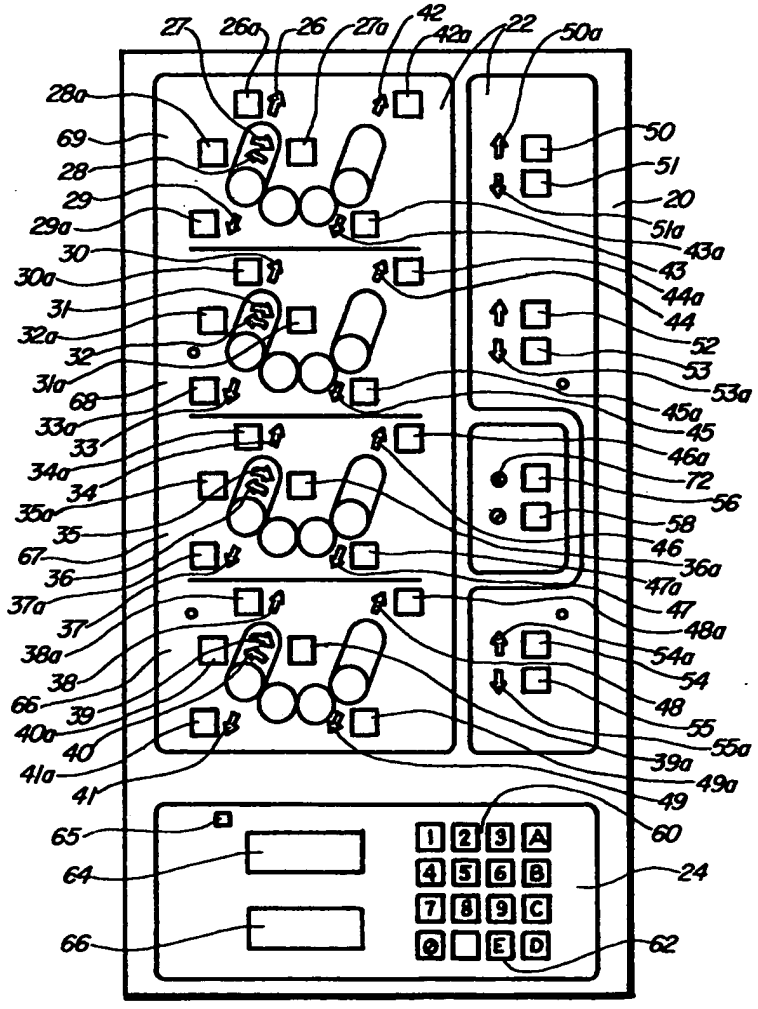

4
3
2
1
PRESS D
FOLDER
PRESS C
FOLDER
PRESS B
FOLDER
PRESS A
CONSOLE D
CONSOLE C
CONSOLE B
CONSOLE A

FIG. 1

FIG. 2


27
26a
26
27a
42
42a
22
50a
28a
69
28
29
29a
30
30a
31
32a
32
31a
68
33a
33
34a
34
35a
35
67
36
37a
37
38a
38
66
39
40a
40
41a
41
50
51
20
51a
43a
43
44a
44
52
53
53a
45a
45
46a
72
56
58
46
36a
47a
47
48a
54a
54
48
55
55a
39a
49a
49
60
24
62
65
64
66
1 2 3 A
4 5 6 B
7 8 9 C
0 E D

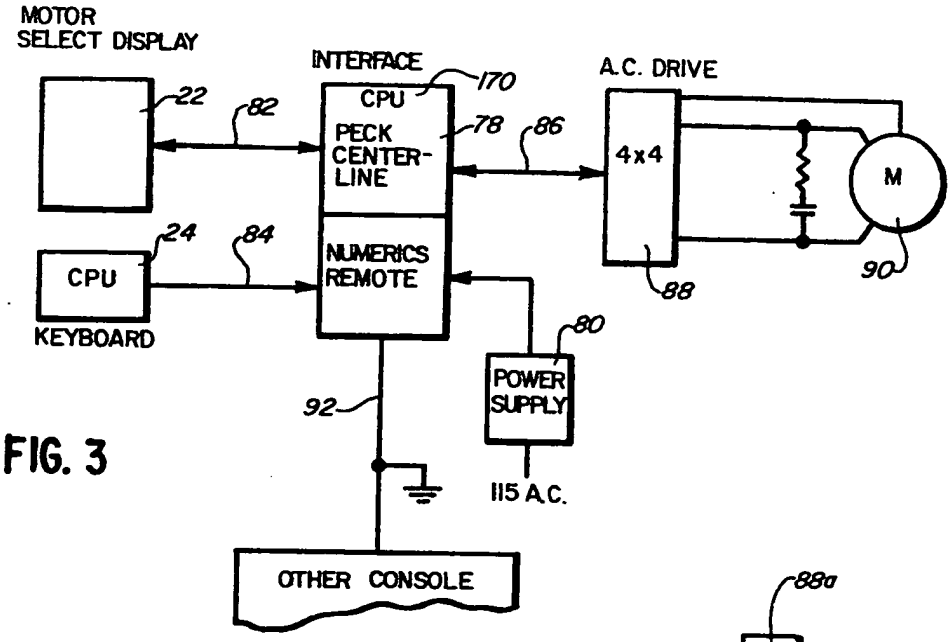


FIG. 3

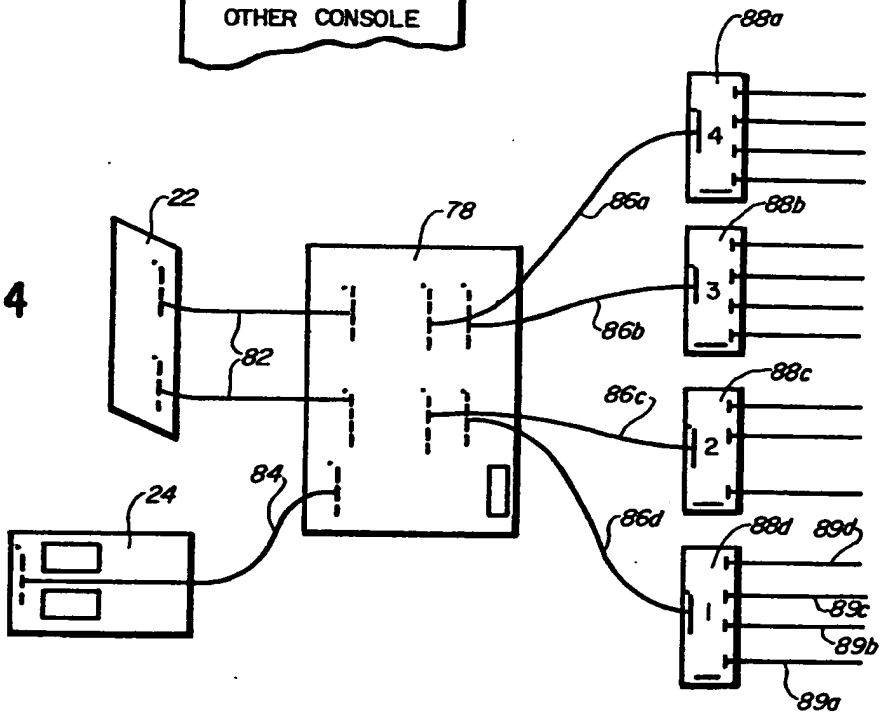


FIG. 4

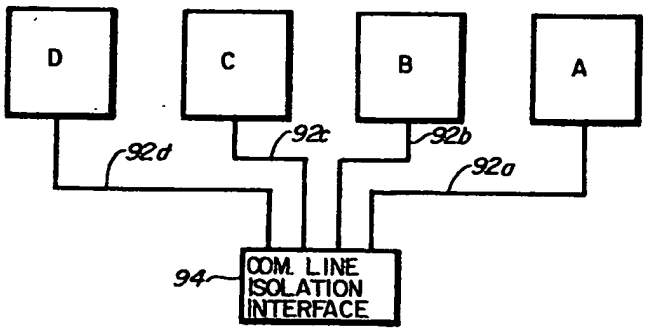


FIG. 5

FIG. 6A

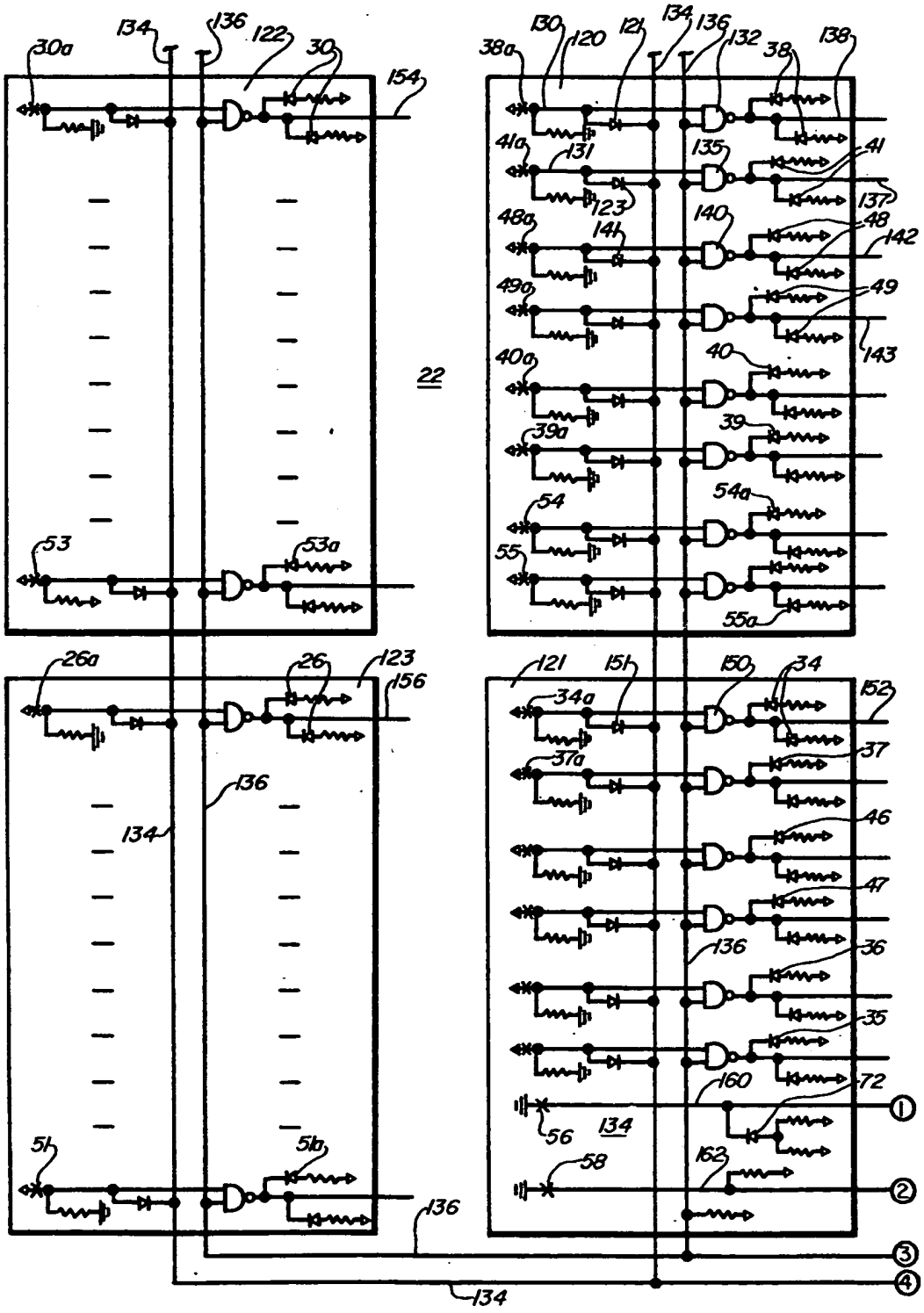

30a
134
136
122
30
154
22
53
53a
26a
26
123
156
136
134
51
51b
136
134
38a
130
120
121
134
136
132
38
138
41a
131
135
41
123
137
48a
141
140
48
142
49a
49
143
40a
40
39a
39
54
54a
55
55a
121
151
150
34
152
34a
37a
37
46
47
136
36
35
160
72
56
134
58
162
1
2
3
4

FIG. 6B

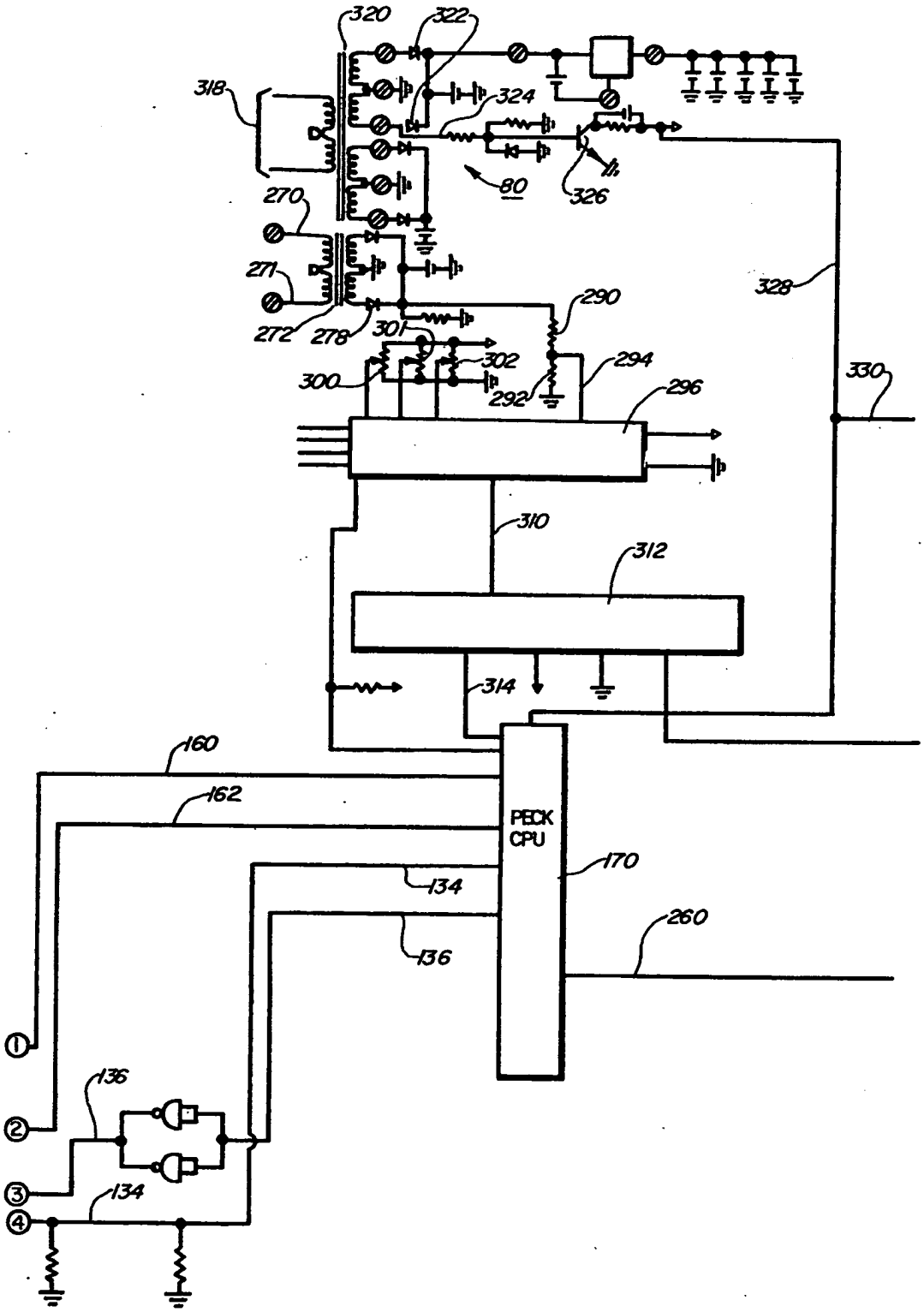

320
322
318
324
80
326
270
271
272
278
301
290
328
300
302
292
294
296
330
310
312
314
160
162
PECK CPU
170
134
260
136
136
134
1
2
3
4

FIG. 7A

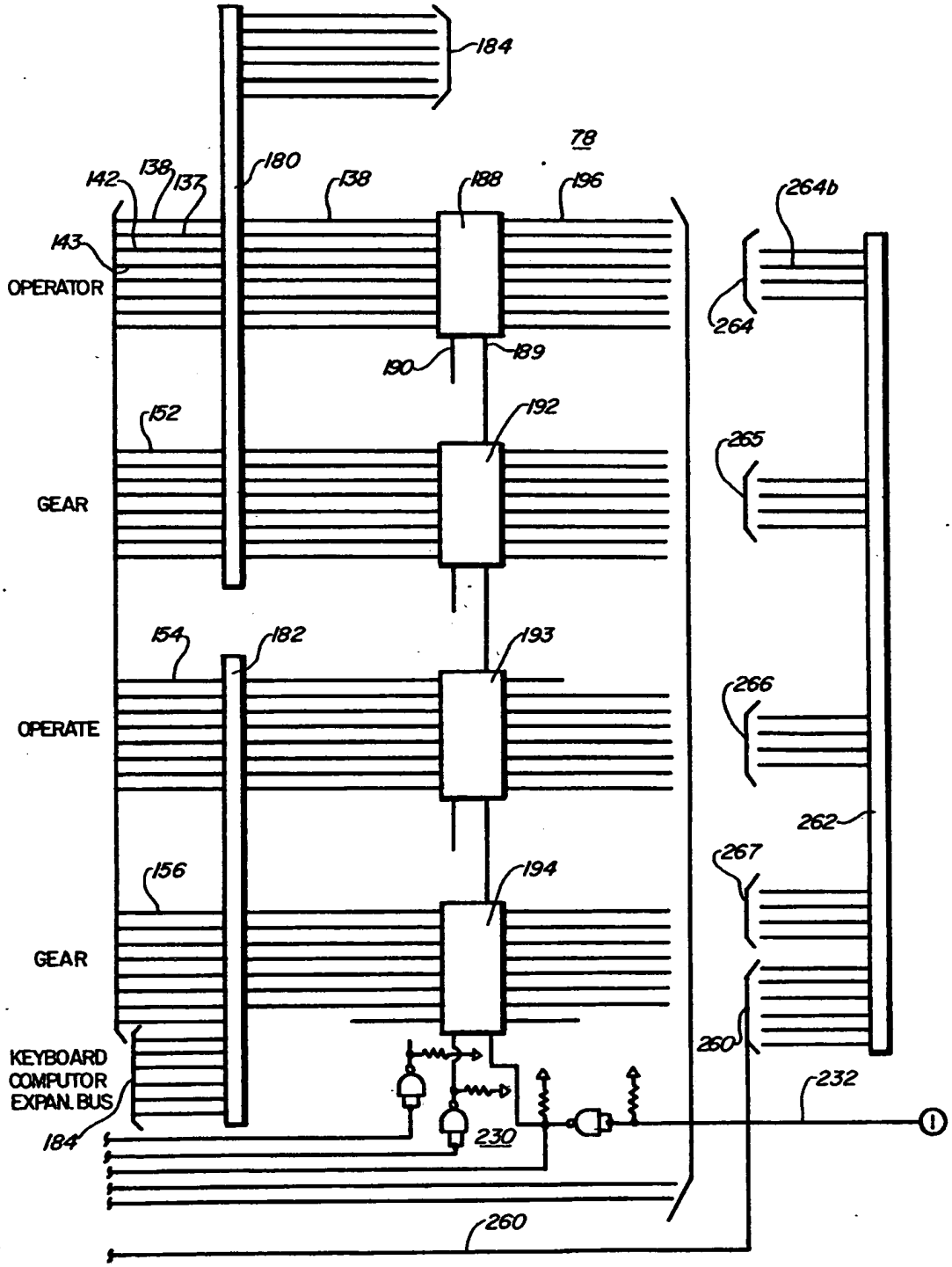

184
78
142
138
137
180
138
188
196
264b
143
OPERATOR
264
190
189
152
192
265
GEAR
154
182
193
266
OPERATE
262
156
194
267
GEAR
260
KEYBOARD
COMPUTOR
EXPAN. BUS
184
230
232
260

FIG. 7B

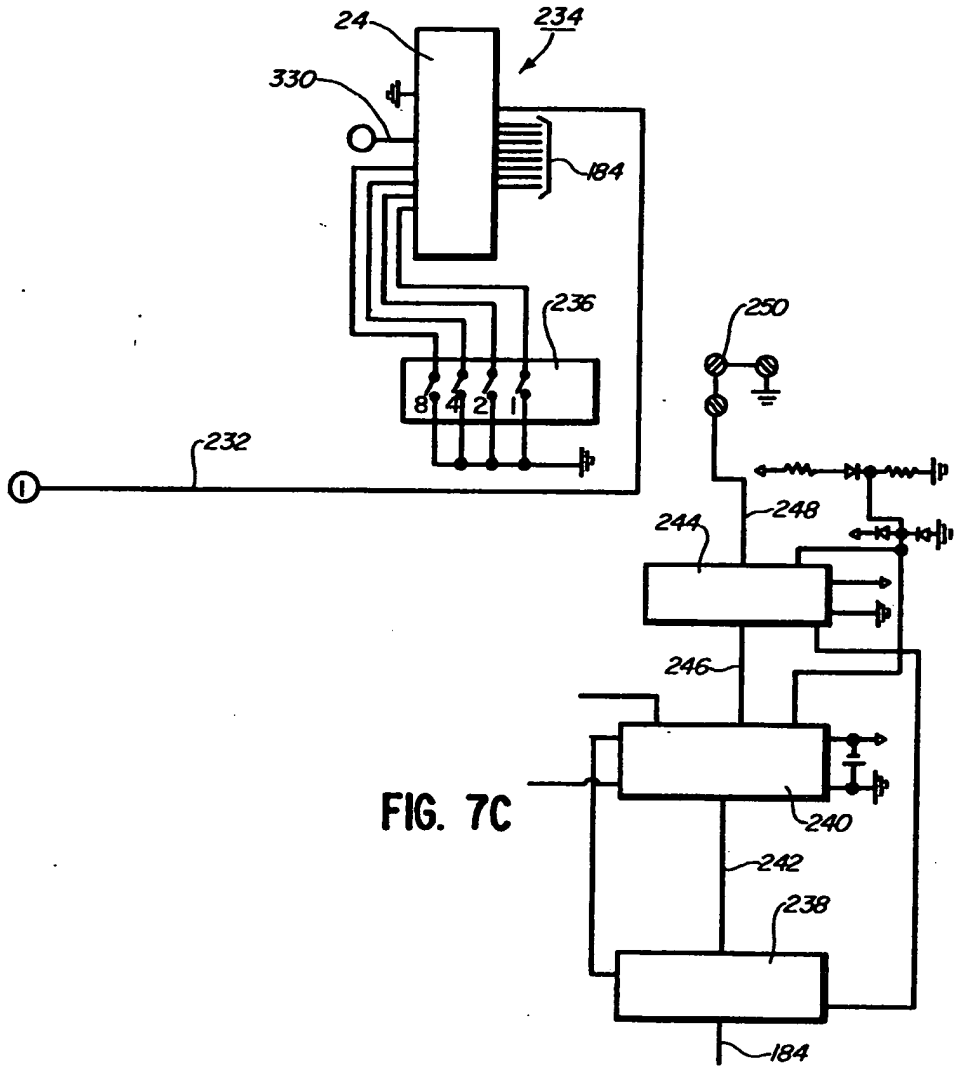


FIG. 7C

FIG. 7D

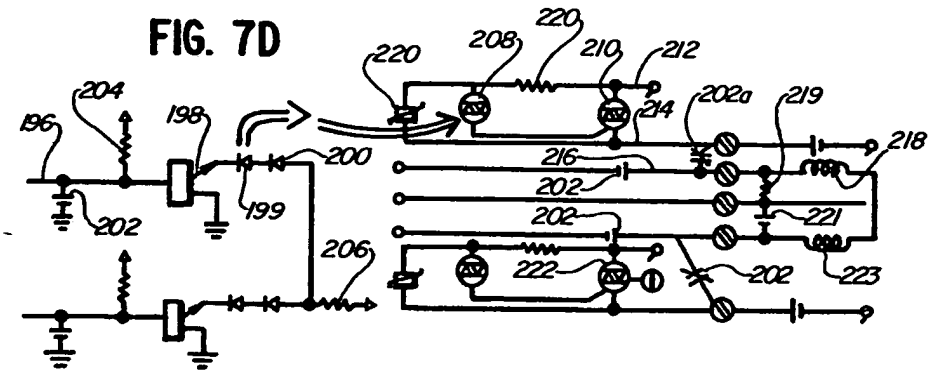


FIG. 8

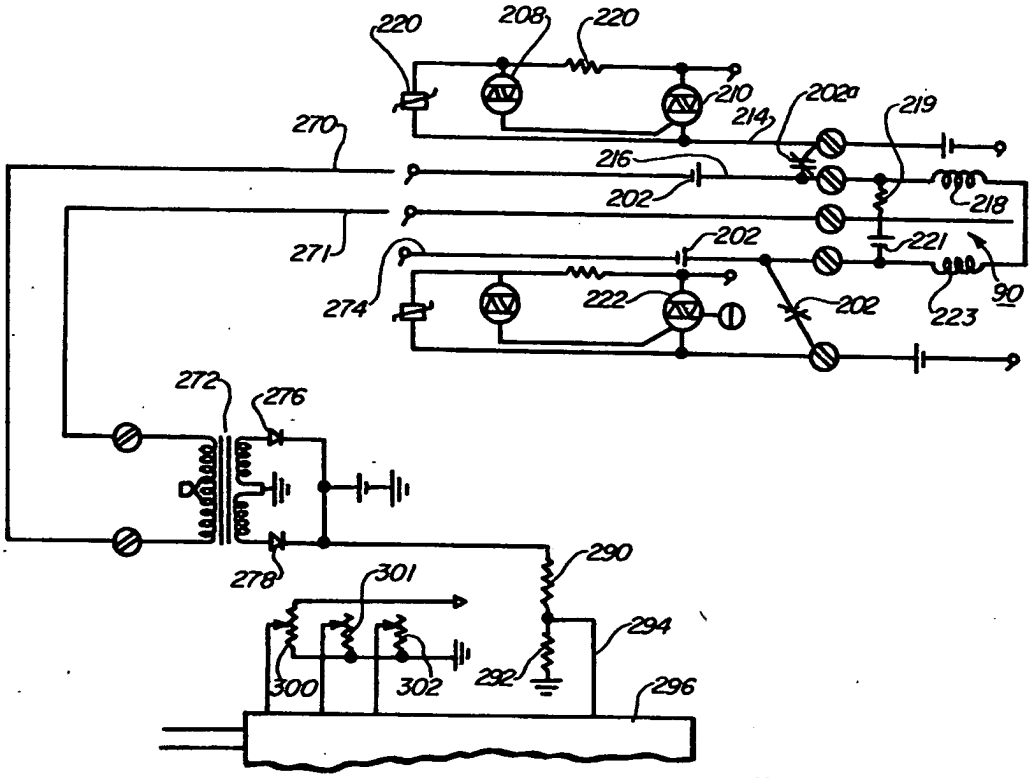


FIG. 9

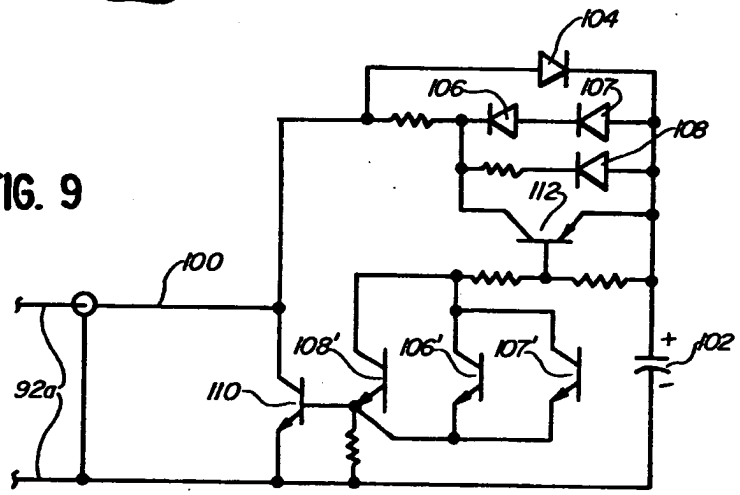


FIG. 10

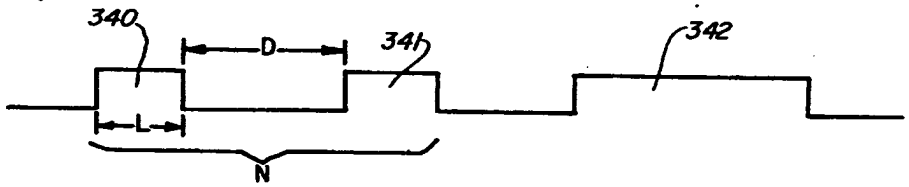


FIG. IIA

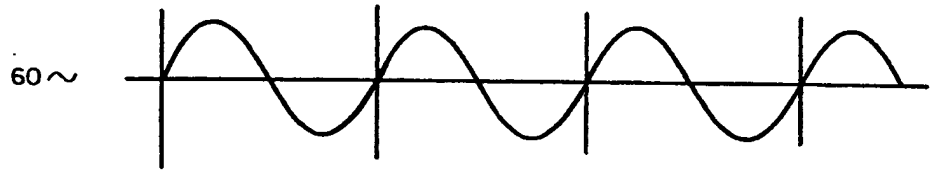


FIG. IIB

FIG. IIC

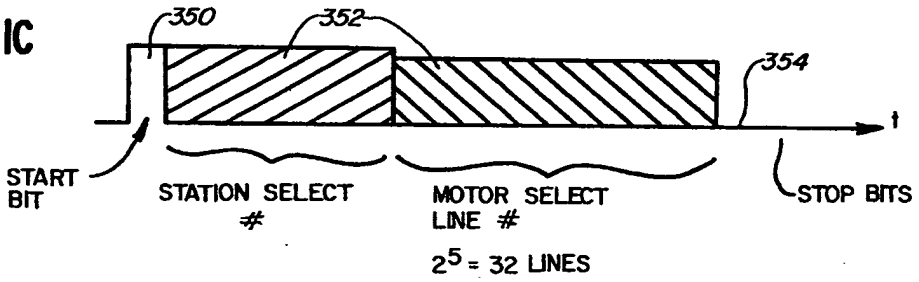


FIG. I2

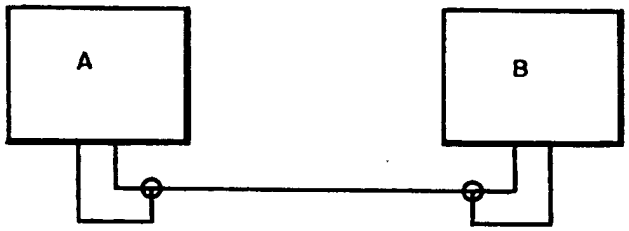
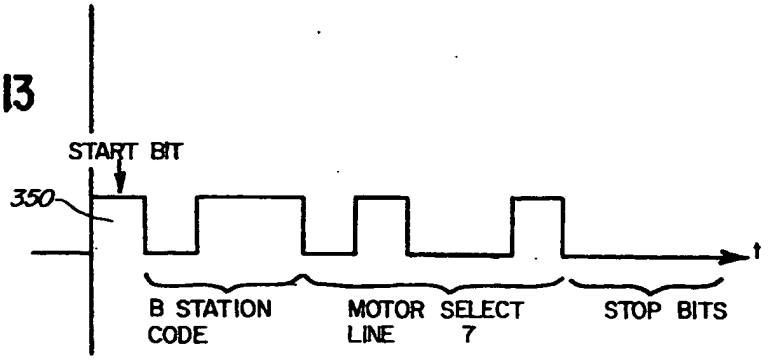


FIG. I3



SPECIFICATION

Register control apparatus and process for printing presses

The present invention concerns a register control apparatus and process for printing presses and, more particularly, a register control system that permits remote control by an operator.

A four-unit color printing press typically comprises a red unit, a yellow unit, a blue unit and a black unit. The units may be stacked vertically or positioned horizontally and they are coupled together to form the press,. A color press may have about 15 register control points for varying the position of the printing plate for proper register. Each plate is mounted on a printing cylinder and when a control handwheel is moved the printing cylinder is moved to reposition the plate cylinder for proper register. Such moves may be axial or the move may be a phase angle (circumferential) correction between the printing cylinders.

In larger systems, there may be several multi-unit presses, each operating on a separate web, with all of the webs terminating at a common delivery and folding point. For example, some printing companies have four adjacent four-unit presses, each having about 15 manual controls, with all 60 controls having to be operated in order to control the total system. The difficulty of operation all 60 controls within a short period of time is apparent for the following reason. In four-unit presses in which the units are stacked vertically, the 15 handwheels for controlling the register adjustment points are not in the same location. They are in different vertical locations and also on opposite sides of the units. Thus in a system with a combination of up to 60 handles, the 60 handles are located in different locations around the unit. A four-unit press may be 14 to 15 feet (4.3 m to 4.6 m) high, requiring access to the handles by means of a ladder. Where a series of four-unit presses are adjacent to each other, the total length may be 150 feet (46 m.) and there needs to be several ladders for access to all of the handles.

However, it is critical that adjustments be made as quickly as possible, because it is improtant for the presses to be made ready as quickly as possible. Therefore, the operator must determine immediately what has to be adjusted. He must run to the appropriate handwheel and make the adjustment as quickly as possible. This often requires climbing and running from press to press rapidly. A press may be running at any speed up to 75,000 impressions per hour. Therefore, if the time taken for adjustments is an hour, up to, 75,000 impressions could be lost.

It is an object of the present invention, to simplify and expedite the aforesaid operation.

In accordance with the present invention, motors are used to move the cylinders and the motors are controlled remotely. This results in a reduction in waste and fewer higher skilled manpower requirements.

One of the features of one embodiment of the present invention is a graphic presentation of the cylinders to be corrected. In the illustrative embodiment, the cylinders to be corrected are presented in a motor select display which enables the operator to view whether lateral or rotational corrections are needed and then push a touch responsive device to make the appropriate correction. In addition, there is a keyboard in which the operator may enter a numerical value representing the correction amount to be made in the system chosen, for example, English or metric.

Another feature of one embodiment of the invention is that the correction is provided by synchronous motors which are fed by alternating current for a time interval that is calibrated with the correction size.

Another feature of one embodiment of the invention is the use of a tactile feel pushbutton switch in the membrane panel of the motor select display, which enables the operator to feel each each click during the operation while at the same time using a membrane type system.

Another feature of one embodiment of the present invention is the use of a plurality of console stations with a communication line between console stations. The communication line in the illustrative embodiment comprises a simple 75 phm TV grade coaxial cable. Each console is used with a single press, whether it be a two-unit, a four-unit, or larger press. Where there are a series of multi-unit presses, there can be a series of consoles with each of the consoles communicating with the others. In this manner, one operator can control all of the consoles and hence all of the presses from a single console.

Another feature of one embodiment of the present invention is the use of circuitry having bidirectional characteristics. This enables certain functions to be independent of each other thereby allowing, for example, an operation which requires directional control (for example, centering) while at the same time enabling movement instructions to one of the other systems which requires a direction from the console to the motor.

Another feature of the illustrative embodiment of the present invention is the provision of a circuit that enables a deliberate motor stall which is utilized to center the cylinder. The stall is created by bringing the cylinder to its end of motion travel (where it can go no further) and the motor shaft cannot turn any further so that it goes into the stall. This allows more rapid centering of the cylinder because once the stall occurs, the circuit knows exactly how far the cylinder needs to travel to return to center.

A more detailed explanation of the invention is provided in the following description and claims, and is illustrated in the accompanying drawings.

Brief description of the drawings

FIGURE 1 is a diagram of a register control system for printing presses constructed in accordance with the principles of the present invention;

FIGURE 2 is a front view of the graphics display of a console of the FIGURE 1 system;

FIGURE 3 is a block diagram of the register motorization of the system of FIGURE 1;

FIGURE 4 is another block diagram of the register system in accordance with the present invention;

FIGURE 5 is a block diagram of the consol communicati n system;

FIGURES 6A and *6B*, when connected togeth r, comprise a schematic circuit diagram of a p rtion of a console of the system of FIGURE 1;

FIGURES 7A, 7B and *7C*, when connected together, comprise a schematic circuit diagram of another portion of a console of FIGURE 1;

FIGURE 7D comprises a schematic circuit digram of the motor control circuitry of the present invention;

FIGURE 8 is a schematic circuit diagram of the sensing circuitry;

FIGURE 9 is a schematic circuit diagram of the communication circuit;

FIGURE 10 is a waveform diagram showing waveform parameters of the of the present invention;

FIGURE 11A is a diagram of the reference 60-cycle signal;

FIGURE 11B is a diagram of the transmit signal;

FIGURE 11C is a greatly enlarged diagram of the transmit signal;

FIGURE 12 is a block diagram of the communication line between consoles; and

FIGURE 13 shows a typical train of information signal in accordance with the present invention.

Detailed description of the illustrative embodiment

Referring to FIGURE 1, the register control system of the present invention is used with a series of four adjacent four-unit presses A, B, C and D. Each of the presses has four vertically stacked units, with the first (lowest) unit being black, the second unit being blue, the third unit being red and the fourth unit being yellow. Folders are located between adjacent presses. A console is provided for remote control of each press with console A controlling press A, console B controlling press B, console C controlling press C and console D controlling press D. However, a communication system is provided so that one of the consoles, for example, console B, may be used as the master control console to control all four of the press. This is described in more detail below.

Referring to FIGURE 2, a graphic display panel is provided for each console, for enabling the operator to make remote adjustments to the printing cylinders. The graphic presentation comprises a plasticized sheet 20 having a motor select display 22 and a keyboard 24 inprinted thereon. A number of synchronous motors are operatively connected to the printing cylinders for moving the printing cylinders in the axial and lateral directions. The motor select display 22 includes a graphic representation of the cylinders capable of movement, with arrows 26-49 indicating the movement direction and also tactile feel switches 26a-49a adjacent the arrows and adapted for manual actuation by the operator to cause movement of the cylinders in the directi n of the arrow adjacent the selected switch. A dual light, for reliability, in the form of two LEDs is located und r each arrow to indicate which switch has been pressed and hence the correction direction of the selected cylinder.

The graphics panel also includes unit to unit register switches 50-55, adjacent arrows 50a-55a, overlying LEDs f r sh wing the correction direction, an all center pushbutton 56 and an all center cancel pushbutt n 58. The keyboard 24 includes correcti n size pushbutt ns 60 numbered "O" through "9", four press selector pushbuttons designated A, B, C and D corresponding to the selected press, and a pushbutton 62 designated E for enabling the console under consideration to be controlled by another console. A status indicator display 64, showing the press selected, is provided and a correction size indicator 66, showing the selected correction size, is provided. Also incorporated on the keyboard is a blind reset switch 65 which allows resetting of the system if any computer malfunctions occur.

In controlling presses A, B, C and D of FIGURE 1, assume that console B will be the console used as the master control console. First, all of the presses are brought up to speed. If the operator at console B is going to control the operations of presses A, C and D as well as B, the A, C and D consoles are placed in the enable mode by pushing button 62 on consoles A, C and D. Now if the operator at master control console B wants to make an adjustment to press A, he presses button A on console B, and the designation "B - - A" will show on display 64.

Still referring to FIGURE 2, graphic display portion 66 concerns unit 1 of the press, graphic display portion 67 concerns unit 2 of the press, graphic display portion 68 concerns unit 3 of the press and graphic display portion 69 concerns unit 4 of the press. Arrows 26, 29, 30, 33, 34, 37, 38, 41, 42, 43, 44, 45, 46, 47, 48 and 49 are the sidelay correction lights and have adjacent sidelay correction switches 26a, 29a, 30a, 33a, 34a, 37a, 38a, 41a, 42a, 43a, 44a, 45a, 46a, 47a, 48a and 49a, respectively. The sidelay correction lights will indicate that a correction is taking place as well as the direction of correction. When in the "pecking mode", described below, these lights will indicate the on/off condition and will show the operator when the system changes from the pecking mode to the continuous running mode. The adjacent sidelay register switches are provided to move the printing cylinders "towards" or "away" as required. The system is set to provide a pecking action when the switch is first pushed. Pecking will produce a fixed known small correction and allow the operator time to remove his finger from the switch to avoid overcorrection. After a predetermined number of pecks, the correction will switch to continuous and correct at the rate of .015 inch (0.038 cm) per second. The size of each peck, the duration between pecks and the number of pecks before continuous running are all adjustable in the field to suit each application.

Arrows 27, 28, 31, 32, 35, 36, 39 and 40 are circumferential correction lights and are provided to show that a correction is taking place. The arrow shows th correction directi n. As in the sidelay indicator lights, pecking or continuous correction is indicated by these lights. Each of these lights has an adjacent switch which is provided to mov th fr nt to back register mechanism. The same pecking syst m described for the sidelay register switches is operabl for circumferential registrati n.

Thus the tactile feel switches, when pressed,

operate in a pecking mode so as to make a discrete amount of movement each tim the pushbutton is pressed. Th amount of movement may be adjusted by adjusting a potentiometer so that the movement may vary from .001 inch (.025 cm) to .015 inch (.038 cm). If the switch is pressed continuously, instead of discrete increments, the movement will be continuous. If a movement of, for example, .006 inch (.015 cm) is required, the operator will enter the correction size by pushing the appropriate correction size switch 60. Thus for a .006 inch (.015 cm) correction, the operator will push the switch designated "6" on keyboard 24. The .006 inch (.015 cm) desired correction will show in display 66. The operator will then push the switch in the motor select display 22 corresponding to the cylinder and movement that is desired. For example, if lateral movement to the right is desired with the printing cylinder of the second unit of press B, in an amount of .,006 inch (.015 cm), the operator presses switch B on keyboard 24, switch "6" on keyboard 24, and switch 35a on motor select display 22. Press B will be designated on display 64, the .006 inch (.015 cm) correction movement will be shown on display 66, and arrow 35 will light up to indicate that the correction is taking place and to show the direction of the correction.

The correction may be made without using the keyboard 24. To this end, as stated above the tactile feel switches on the motor select display operate in a pecking mode so as to make a discrete amount of movement each time the pushbutton is pressed. If the peck is set for .001 inch (.025 cm) per peck, each time the operator presses the particular switch there will be a correctional movement of .001 inch (.025 cm). This instead of pushing the switch 60 designated "6" on keyboard 24, the operator could press switch 35a on motor select display 22 six times. This would have the same effect as pushing the switch 60 designated "6" and then pushing switch 35a once.

Switches 50-55 are unit to unit correction lights which are provided to show the correction and direction of correction for unit to unit registration. The adjacent arrows indicate the pecking versus continuous running as with the other arrows described above. All center switch 56 is provided to neutralize (i.e., move to the center) sidelay, back to back and circumferential register mechanism. Switch 56 is used when changing jobs to facilitate rapid make-ready and registration. Adjacent light 72 will illuminate when switch 56 is activated and will remain on until all register mechanisms are centered and the press compensation is back in its "ready" condition.

Switch 58 is used to cancel an "all center" command, before the "all center" sequence is completed.

The corrections are provided by synchronous motors which are fed by alternating current for a tim interval that is calibrated with th correction size. For example, assume an alternating current frequency of 60 h rtz is utilized. The synchronous motors are calibrated so that the motor will cause a .015 inch (.038 cm) correction movement in on second. Thus for ev ry 1/15th of a second, there is a .001 inch (.025 cm) correction movement. If a .001 inch (.025 cm) correction m vement is desired, the m tor is provided with four cycles of alternating current, which equal 1/15th of the 60 cycles. Additionally, the alternating current line is synchronized so that each time the synchronous motor is energized, it commences with the zero crossing of the alternating current cycle; not anywhere else on the alternating current cycle. Thus for 60 hertz power, the .015 inch (.038 cm) correction movement will take one second. It should be noted, however, that the frequency of the alternating current is immaterial because the motor is synchronized to provide a .015 inch (.038 cm) correction movement for one complete second at any frequency. Thus assuming the frequency is 50 hertz, in one second there will still be a .015 inch (.038 cm) movement. If .0075 inch (.019 cm) movement is desired, only 25 cycles (i.e., one half second of alternating current) will be provided to the motor. This timing is applicable notwithstanding the frequency.

Instead of using conventional membrane switches on the console in the illustrative enbodiment, there are pushbuttons located under the plasticized display sheet 20. In this manner, the operator will feel each click although it will have the advantage of a planar overlay with the membrane feel.

In FIGURE 3, a console block diagram is illustrated including the motor select display 22, keyboard 24 with keyboard computer, and interface 78 including a computer, peck circuitry, center line circuitry, numerics-remote control circuitry, and a power supply 80. The motor select display 22 is coupled to the interface computer, peck circuitry and center line circuitry via line 82 and the keyboard computer 24 is coupled to the numerics-remote circuitry via line 84. The output 86 if interface 78 controls AC drivers 88 which are connected to the numerous synchronous motors 90 which are operatively connected to the cylinders for movement of the cylinders. The console of FIGURE 3 is connected by a 75 ohm TV grade coaxial cable 92 to another console through a com. line interface 94 (FIGURE 5).

Referring to FIGURE 4, it can be seen that display 22 and keyboard/ controller 24 are connected to interface 78 via lines 82 and 84, respectively, and four drivers 88a-88d are coupled to interface 78 via lines 86a-86d for controlling the four units of a press. Output line 89a from driver 88d controls the side circumferential motor of unit 1, output line 89b controls the unit 1 to unit 2 correction motor in which the lowest unit 1 is moved into register with fixed unit 2, output line 89c is used to control one of the sidelay correction motors of unit 1 while output line 89d is connected for controlling the other sideay correction motor of unit 1. With respect to driver 88c, n of its utput lines controls th circumferential correcti n motor, an ther output line controls a sidelay correction motor, another output line is not used and another utput lin controls the oth r sidelay correction mode. With respect to driver 88b, one of th output lines controls the circumferential correcti n motor, anoth r output lin controls the unit 3 to unit 2 correcti n m t r, an ther output line controls a sidelay correcti n motor, and the fourth

output line controls th ther sidelay correction motor. With respect to driver 88a, one of the utlet lines controls the circumferential correction motor of unit 4, another output line controls a sid lay correction motor of unit 4, another output line controls the unit 4 to unit 2 correction motor, and the other output line controls the other sidelay correction motor of unit 4.

Each of the lines (89a, 89b, 89c and 89d) which form an output of driver 83d comprises three wires. Thus driver 88d actually has 12 output wires as does driver 88b and driver 88a. Driver 88c has 9 output wires. The purpose of each of the drivers is to change the five volt input to a 120 volt output required to drive the motor. A 50 or 60 hertz 120 volt alternating current input is provided to each motor. As indicated in FIGURE 4, there are 15 motors used in connection with the present register control system for each press. The three-wire connection to each motor is illustrated in FIGURE 7D and 8, which are discussed in more details below.

Referring to FIGURE 5, it can be seen that control consoles A, B, C and D are connected by 75 ohm TV grade coaxial cable 92a, 92b, 92c and 92d to a communication line isolation interface 94. It has been found that the ground between each of the presses in a multi-press system should not be the communication line 92. In other words, the ground of coaxial cable 92 should not serve as the common ground for all four consoles or all four presses. This is because some presses are running on as much as a 1,200 amp line and this would provide enough kick to cause interference between the consoles; thus it has been found that electrical isolation between consoles should be provided. Thus a com. line interface or junction box 94 is provided in which all of the consoles are connected to each other via optical isolation means. The optical isolation means preferably comprises four capacitors in the interface 94. Each of the capacitors acts as a power supply. There are opto isolators, with each capacitor operating with three of the opto isolators. Thus referring to FIGURE 9, coaxial cable 92a from console A is illustrated with line 100 being high (for example, five volts DC) to charge capacitor 102 via diode 104. If console A begins to transmit, then opto isolator diodes 106, 107 and 108 are activated, causing their respective transistors 106', 107' and 108' to conduct. Opto diode 106 is opto coupled to transistor 106' which controls console C, while opto diode 107 is opto coupled to transistor 107' controlling console B while opto diode 108 is opto coupled to transistor 108' which controls console D.

Now assume that there is a signal from coaxial cable 92d. Then transistor 108' will turn on, which turns on transistor 110, and also turns on transistor 112. Transistor 110 sends the signal coming from coaxial cabl 92d back over th coaxial cable to console A. Transistor 112, turning on, shorts out opto diodes 106, 107 and 108 to prevent them from sending a latch signal back to their respective transistors,

If capacitor 102 discharges for any reason, the ntire circuit is disabled. This would not affect th oth r three circuits, however. Thus FIGURE 9 shows one of th four opt isolation circuits present in the communication isolati n interface 94 of FIGURE 5. The circuit may or may not be used depending n the ground is lation between systems.

Now referring to FIGURE 6A, it can be seen that there is a control circuit for each unit of the press. While the following discussion will refer to press A, the same discussion is applicable to the other presses.

Control circuit 120 controls unit 1 of press A, control circuit 121 controls unit 2; control circuit 122 controls unit 3; and control circuit 123 controls unit 4. Each control circuit 120, 121, 122 and 123 has eight input control lines. The switches and LEDs of FIGURE 6A have reference numerals which correspond to the reference numerals on the panel illustrated in FIGURE 2. Now referring to control circuit 120 for unit 1, it is seen that switch 38a is coupled to high (for example, a five volt) line 130 which is at an input of NAND gate 132. It also is connected to diode 121 and to start line 134. Start line 134 is common to all 30 switches in all of the four control circuits 120, 121, 122 and 133, and it also is connected to a computer in the interface 78 and a computer in the keyboard control 24. The interface computer responds with an active high on peck line 136. Peck line 136 is also common to all 30 switches. The peck line 136 is inputted to another input of NAND gate 132, resulting in a low signal on line 138. LEDs 38, which are positioned under the graphic panel 22 (FIGURE 2), become energized and effectively light up the arrow showing the movement direction of the cylinder. There are two LEDs for each arrow.

Likewise, switch 41a is connected to high line 131 and through diode 123 to common start line 134. When switch 41a is activated, the interface computer responds with an active high on peck line 136. The peck line is inputted to NAND gate 135 resulting in a low signal on line 137. LEDs 41 become energized to light up the arrow showing the movement direction of the cylinder.

Likewise, switch 41a is connected to an input of NAND gate 140 and through diode 141 to common start line 134. When switch 48a is activated, the interface computer responds with an active high on peck line 136, with the peck signal being inputted to an input of NAND gate 140, resulting in a low signal on line 142. LEDs 48 become energized to light up to arrow showing the movement direction of the cylinder. In the same manner, when switch 49a is energized, a low signal on line 143 results and LEDs 49 are energized. A similar operation occurs with respect to actuation of switches 40a, 39a, 54 and 55 and from the foregoing discussion it can be seen how all four motors of unit 1 are controlled.

By referring to the reference numerals on FIGURE 2 and comparing them to the reference numerals on FIGURE 6A, the operation of th control circuits 120-123 can be readily understood. For example, with respect to control circuit 121 f r controlling unit 2 of the printing press, it can be seen that switch 34a is connected to an input of NAND gate 150 and is connected through diode 151 to common start line 134. When switch 34a is actuated, the interface computer responds with an active high on peck line

136, which is connected to the other input of NAND gate 150. This results in a low signal n line 152 and LEDs 34 will becom nergized. Likewis , ref rring to control circuit 122 for controlling unit 3 of the printing press, when switch 30a is activated, there will be a low signal on line 154 and LEDs will be energized. When switch 26a of control circuit 123 is activated, there will be a low signal on line 156 and LEDs will become energized.

Referring back to control circuit 121, it can be seen that switch 56 is connected to center line control line 160 and operates to ground line 160 when switch 56 is activated and also to energize LED 72. Switch 58 is connected to cancel line 162 and operates to ground cancel line 162 when switch 58 is activated. referring now to FIGURE 6B, it can be seen that center line control line 160, cancel line 162, common start line 134 and peck line 136 are connected to peck computer 170.

While FIGURE 6A was the display panel 22, interface 78 is effectively illustrated in FIGURE 7A. Thus output lines 138, 137, 142 and 143 from control circuit 120 (FIGURE 6A) become the input lines (with the same reference numerals) to interace 78 (FIGURE 7A). The output lines from the display panel are connected to bidirectional input/output chips 180, 182 of FIGURE 7A.

Still referring to Figure 7A, keyboard computer expansion bus lines 184 are also connected to bidirectional input/output chips 182, 185, respectively. These keyboard computer expansion lines 184 are coupled to the keyboard computer. Although no limitation is intended, chips 180, 182 are Intel 8243 chips and the keyboard computer is an Intel 8748 microcomputer. Line 138 continues from chip 180 to chip 188 which is an opto buffer 74 LS245 chip. The enabling of chip 188 is controlled by the keyboard computer via terminal 189 and the direction is controlled by the pecking computer via terminal 190. In a centering operation, the information is returned from the driver board in the direction toward the display board. In this manner, the circuit of the present invention is bidirectional. The enable line, which is controlled by the keyboard, indicates to the chip that the information is being sent from the keyboard to the motor. On the other hand, the direction line, which is enabled by the pecking computer, indicates to the chip that the information is directed from the motor back to the display. These functions are independent of each other in that an operation which requires the directional control (for example, centering) could be occurring while at the same time movement instructions may be given to one of the other systems which requires a direction from the keyboard to the motor.

While opto buffer chip 188 is operable with respect to unit 1, opto buffer chip 192 is operabl with respect to unit 2, opto buffer chip 193 is operabl with respect to unit 3 and opto buffer chip 194 is operabl with respect to unit 4. The discussi n operati n with respect to opto buffer chip 188 is applicable with respect to opto buffer chips 192, 193 and 194.

Still referring to FIGURE 7A, output lin 196 from opto buffer chip 188 is connected to the driver for the corresponding motor f unit 1. Likewise, the utput lines from opt buff r chip 188 ar connected to the respective buffers for the respective motors f unit 1. Similarly, the output lines from opto buffer chips 192, 193 and 194 are connected to the respective drivers for the motors of units 2, 3 and 4. The operation of the drivers is illustrated by referring to FIGURE 7D.

Referring to FIGURE 7D, line 196 from opto buffer chip 188 (of FIGURE 7A) is illustrated at the left-hand side of the circuit diagram. Line 196 is connected to the base of NPN transistor 198, having its collector grounded and the emitter being coupled through opto isolator 199 and LED 200. A relay contact 202 is connected to line 196 and this relay contact is pulled during the centering operation which is discussed in more detail below. Resistor 204 is a pull-up resistor to the five volt high line and resistor 206 is also coupled to the five volt high line. Opto coupler 199 provides the light and is coupled to opto triac 208. Such opto coupling is utilized to insure that the 120 volts is isolated from the computer. Opto triac 208 triggers main triac 210. This conducts neutral AC voltage from line 212 over to line 214, through normally closed relay contact 202a, to line 216 which is coupled to motor winding 218, thereby energizing the motor. Resistor 220 is a current limiting resistor to keep the current low enough to prevent triac 208 from being damaged. A varistor 220 is used to prevent excessive voltage. A phase shift capacitor network including resistor 219 and capacitor 221 is connected between motor winding 218 and motor winding 223.

In summary, when switch 38a (FIGURE 6A) of control circuit 120 is actuated, the system will effectively be energized to activate triac 210 (FIGURE 7D), thereby energizing the motor in the first direction. In a similar manner, if switch 41a were actuated, triac 222 (Figure 7D) would be activated to energize the motor in the reverse direction in the same manner that triac 210 actuated the motor in the first direction. The other switches of the control circuits 120, 121, 122 and 123 of FIGURE 6A operate in the same manner on corresponding lines to actuate triacs to control the motors.

Referring to the lower portion of FIGURE 7A, there is a buffer circuit 230 comprising NAND gates and resistors which operate jointly to provide buffering for the internal select buffering line chips 188, 192, 193 and 194. An input line 232 is from the keyboard display controller 234 which includes the keyboard computer 24 (FIGURE 7B) having keyboard computer expansion bus 184 connected thereto. Referring to FIGURE 7B, binary switch 236 has a rotary dial to signal the computer with respect to which console is being operated. Assuming that there is a separate consol for each of presses A, B, C and D, is switch 236 is being handled with respect to consol B, the whe l is turned to indicate that it is console B and switches 8, 2 and 1 will be closed. Likewise, if it w re console C a diff r nt series of switches would be closed.

The keyboard computer expansi n bus 184 which is connected to keyboard computer 24 extends to chips 180 and 182 of FIGURE 7A and also is

connected to input/output expand r chip 238 (FIGURE 7C) which is an 8243 I/O expander. Chip 238 is connected to serial to parallel and parall l to serial communication line chip 240 via line 242 and chip 240 is connected to driver chip 244 via line 246. Driver chip 244 is connected via line 248 to coax terminal 250. Coax terminal 250 may be coupled via 75 ohm TV grade coaxial cable to the other consoles.

Another novel feature of the present invention is the stall sense circuit. Referring to FIGURE 6B, there is shown peck computer 170 with input/output bus 260 connected thereto. Now referring to the lower section of FIGURE 7A, it is seen that input/output bus 260 is connected to centering chip 262. Centering chip 262 is an 8243 I/O expander chip. Also coupled to centering chip 262 are centering control leads 264, 265, 266 and 267, with each lead comprising four wires going into one of the driver boards associated with each unit of the printing press. When the peck computer activates a lead via bus 260, such as lead 264b, lead 264b goes high. Line 264b is connected to a driver chip so that when line 264b is high, relay 202 (FIGURE 7D and FIGURE 8) becomes activated.

Referring to FIGURE 8 in particular, when relay 202 becomes activated, the status shown in FIGURE 8 changes so that the driver circuitry effectively becomes disconnected from the motor windings. The motor windings then effectively become connected to sense lines 270 and 271 which are connected to transfer 272. For sensing purposes, a neutral voltage is applied from an external source to line 274 and a 120 volt alternating current signal is always from an external source applied to line 271. The 120 volts on the motor across lines 271 and 274 generates a secondary voltage on line 270, which is a phase shifted voltage with respect to the voltage across lines 271 and 274. The idle or free run voltage is about 155 volts AC. When the motor moves to the end of the allowed movement, so that the shaft is prevented from moving further (i.e., stall), the sense voltage on line 270 drops to about 110 volts AC. That sense voltage is lowered by stepdown transformer 272 and is rectified by diodes 276 and 278 to provide a DC voltage across the voltage divider comprising resistors 290 and 292. This DC voltage on line 294 is provided to an A to D converter chip 296 to provide a digital output signal equivalent to the sense voltage.

As stated above, the secondary voltage is normally about 155 volts and is lowered to about 110 volts when the motor stalls. When there is a transition from the 155 volts downward to about 130 volts, the circuit is set so that the sensed voltage being 130 volts or less indicates a stall. This is a deliberate stall because it is being used to center the cylinders. The stall is created by bringing the cylinder to its end of motion travel where it can go no further and the motor shaft cannot turn any further so it goes into the stall. Normally, travel from on nd of the cylind r direction to the oth r end of th cylinder direction takes 16 seconds. By centering the position, the averag travel of the cylinder is reduced to 8 seconds. In addition, the motor is prevented from forcing the cylind r to hit the wall for a l ng period of time because the circuit promptly brings the cylinder back to center. Thus once the stall occurs, th sensing lead 270 is powered (by placing the 120 volts across lines 270 and 271) for a known period of time (8 seconds) in the reverse direction so that exactly how far the cylinder will trav l is predetermined and it is also predetermined that the cylinder will promtly be brought back to center from the stall, because it is predetermined that in 8 seconds of motor turning the distance travel will be half of the distance from wall to wall. It is preferred that all of the motors be referenced off the same wall so that they are centered in relation to each other. Certain cylinders may require a different time period to bring them back to center or another selected position.

Referring back to FIGURE 8, A to D converter 296 converts the voltage to a single byte. Potentiometers 300, 301 and 302 are adjusted to provide particular voltage outputs which the computer uses to select the pecking functions. For example, potentiometer 302 sets the length of the peck from .001 inch to .015 inch. Potentiometer 301 sets the length of the delay into an equivalent off time. As stated above, the system is calibrated so that one second of motor rotation corresponds to .015 inch movement.

Potentiometer 300 determines the number of pecks, from 0 to 15, before going into a continuous "on" condition. Thus potentiometer 300 is set for the number of pecks per single touch, meaning that if the operator touches the switch once and potentiometer 300 is set for two pecks, there will be two pecks for each single touch. Every peck is a precision peck calibrated to a particular motion such as .006 inch.

Some of the stall sense circuitry which is shown in detail in FIGURE 8 is also illustrated in FIGURE 6B. Referring to FIGURE 6B, it is seen that the A to D converter chip 296 is coupled via line 310 to an 8243 I/O expander chip 312. Expander chip 312 is connected to an input or output of peck computer 170 via line 314.

At the upper portion of FIGURE 6B, the power supply 80 is shown wherein the household current (for example, 115 VAC) is coupled to input 318 and is reduced to five volts DC via stepdown transformer 320 and rectifier 322. A line 324 from the secondary of transformer 320 is connected to the base of NPN transistor 326 to provide a clocked AC signal at the collector of transistor 326 which is fed via line 328 to the peck computer 170. The clocked AC signal is also fed via line 328 and line 330 to keyboard computer 234 (FIGURE 7B).

Referring now to FIGURE 10, each of the pulses 340, 341 and 342 comprises a peck. The length L of the peck (the length of the movement) is controlled by potentiometer 302 (FIGURE 8), the delay D between packs (the spaces between the pulses) is controlled by potentiometer 301 and the number N of pecks is controlled by potentiometer 300.

Referring to FIGURE 12, this figure is indicative of the system having communicati n between console A and consol B. Now ref rring to FIGURE 11A, the reference 60 hertz (or optional 50 hertz) AC signal is shown therein as th timing signal. At the beginning of the cycle, for about 3 milliseconds, the information signal is sent from, for exampl , console A to console B. The information signal which is transmit-

ted is shown in FIGURE 11B and is enlarged greatly in FIGURE 11C. Referring to FIGURE 11C, the signal comprises a start bit 350, eight data bits 352 and a stop bit 354. The eight data bits 352 consist of three station select bits and five motor select bits. In the illustrative embodiment, the start bit is always a 1. The bit cells are amplitude modulated to determine whether the signal is a 1 or a 0, with the 1's being higher than the 0's in the illustrative embodiment. It is to be understood, however, that pulse width modulation or any other type of encoding could be utilized for indicating whether the bit is a 1 or a 0. In the illustrative embodiment, the stop bits are 0's.

Referring to FIGURE 13, a typical train of information signals is illustrated. In the FIGURE 13 illustration, the start bit 350 is a 1, the next three bits are 0, 1, 1 which indicates the B station, the next five bits are 0, 1, 0, 0, 1 which indicates motor select line 9, and therafter stop bits 0, 0 are presented.

It can be seen that in accordance with the present invention, there may be a series of consoles with each of the consoles communicating with each other. Thus a single operator can control all of the consoles and hence all of the presses from a single point. The communication line may comprise a simple 75 ohm TV grade coaxial cable. It is not essential that all of the consoles have a graphic display module or a keyboard. If there are four presses A, B, C and D, and it is known that all of the presses will be controlled from location B, only the location B console requires the graphic display and the keyboard. The A, C and D consoles only need the interface if the operator will always be at location B for controlling all of the presses.

CLAIMS

1. A register control apparatus for printing presses which comprises;

a plurality of motors for moving printing cylinders of a press to provide register correction;

a remote console coupled to the motors for controlling the operation of the motors and hence the correction size;

said remote console including rouch-actuated means adapted for manual actuation to cause movement of the cylinders for a selected correction; and means for calibrating the cylinder movement with respect to pecking of said touch-actuated means.

2. A register control apparatus for printing presses which comprises:

a plurality of motors for moving printing cylinders of a press;

a remote console coupled to the motors for controlling the operation of the motors and hence movement of the printing cylinders;

said remote console including a graphic representation of the cylinders capable of movement, with arrows indicating movement direction, touch-actuated means adjacent the arrows adapted for manual actuation to cause movement of the cylinders in the direction of the arrow adjacent the selected touch-actuated means; and

means for calibrating the movement amount with respect to the manual actuation activity.

3. A register apparatus according to Claim 1, said touch-actuated means being located on a graphic display including a motor select display and a keyboard, said keyboard having switches for selecting the desired correction size, and means for controlling said correction size in response to pecking of said touch-actuated means.

4. A register control apparatus according to Claim 2, said graphic representation including a keyboard having switches for selecting the desired quantity of printing cylinder movement.

5. A register control apparatus according to Claim 2, said graphic representation including a separate representation of each of the printing press units, and including means for selecting the unit to be operated and means for selecting the desired quantity of printing cylinder movement for a selected printing cylinder of a selected unit.

6. A register control apparatus according to Claim 1 or 3, said motors comprising synchronous motors and including means for providing an alternating current to said synchronous motors for a time interval that is calibrated with each peck of said touch-actuated means.

7. A register control apparatus according to Claim 2, 4 or 5, said motors comprising synchronous motors; and means for calibrating the synchronous motor movement with respect to the manual actuation activity, said calibration means including means for providing an alternating current to said synchronous motors for a time interval that is calibrated with the desired printing cylinder movement.

8. A register control apparatus according to Claim 6 or 7, said alternating current providing means comprising means for providing a number of alternating current cycles calibrated with the desired printing cylinder movement.

9. A register control apparatus according to Claim 6, 7 or 8, wherein said alternating current cycles to said synchronous motors commence with the zero crossing of an alternating current cycle.

10. A register control apparatus according to Claim 6, 7, 8 or 9, said alternating current providing means comprising means for providing 50/60 hertz alternating current to cause a .015 inch (.038 cm) printing cylinder movement per second.

11. A register control apparatus according to any preceding claim, said touch-actuated means comprising membrane means overlying pushbutton switches.

12. A register control apparatus according to any preceding claim, including a plurality of said remote consoles, each being operable to control the printing cylinders of a different press;

a plurality of communication lines interconnecting said remote consoles, and

an isolation interface for providing electrical isolation between consoles except when communication signals are transmitted.

13. A register control apparatus according to Claim 12, said electrical isolation providing means comprising opto isolation means and said communication lines comprising 75 ohm TV grade coaxial cables.

14. A register control apparatus for a plurality of

multi-unit printing presses, which comprises:

a plurality f synchronous motors for moving printing cylinders of the presses;

a plurality of remote consoles coupled to the motors for controlling the operation of the motors and hence movement of the printing cylinders, each of said remote consoles being operable to control the printing cylinders of a different press;

at least one of said remote consoles including a graphic representation of the cylinders capable of movement, with arrows indicating movement direction, touch-actuated means adjacent the arrows adapted for manual actuation to cause movement of the cylinders in the direction of the arrow adjacent the selected touch-actuated means;

said graphic representation including a separate representation of each of the printing press units, and including means for selecting the unit to be operated and means for selecting the desired quantity of printing cylinder movement for a selected printing cylinder of a selected unit;

means for calibrating the synchronous motor movement with respect to the manual actuation activity, said calibration means including means for providing an alternating current to said synchronous motor for a time interval that is calibrated with the desired printing cylinder movement.

said alternating current providing means comprising means for providing a number of alternating current cycles calibrated with the desired printing cylinder movement with said alternating current cycles ot said synchronous motors commencing with the zero crossing of an laternating current cycle; and

a plurality of communication lines interconnecting said remote consoles, and an isolation interface for providing electrical isolation between consoles except when communication signals are transmitted.

15. A register control apparatus for printing presses which comprises:

a plurality of motors for moving printing cylinders of a press to provide register correction;

a remote console coupled to the motors for controlling the operation of the motors and hence the correction size;

said remote console including touch-actuated means adapted for manual actuation to cause movement of the cylinders for a selected correction;

means for centering each cylinder for subsequent operation, said centering means comprising means for first bringing the cylinder to a predetermined limit position in a first direction, and means for thereafter powering the motor controlling said cylinder to move said cylinder in the reverse direction for a predetermined time period.

16. A register control apparatus according to Claim 15, said predetermined limit position being a positi n at which the cylinder motor has stalled, and said predetermined time period being the amount of time required to bring th cylinder from said predetermined limit position to th center positi n.

17. A register control apparatus according to Claim 15 or 16, said motors comprising synchron us motors and said centering means including means for sensing a stall of the cylinder motor ad means for thereafter powering the cylind r mot r in the reverse direction for th predetermined time period required to bring the cylinder back from stall to the center positi n.

18. A register control apparatus according to Claim 15 or 16, said motors comprising synchronous motors, and means for calibrating the synchronous motor movement with respect to the manual actuation activity, said calibrating means including means for providing an laternating current to said synchronous motors for a time interval that is calibrated with the desired printing cylinder movement.

19. A register control apparatus according to Claim 18, said alternating current providing means comprising means for providing a number of alternating current cycles calibrated with the desired printing cylinder movement, said alternating current cycles to said synchronous motors commencing with the zero crossing of an alternating current cycle.

20. A process for controlling color register on multi-unit printing presses, comprising the steps of:

providing a plurality of motors for moving the printing cylinders of the press;

coupling to said motors a remote console for controlling the operation of the motors and hence controlling movement of the printing cylinders;

providing on said remote console a graphic representation of the cylinders capable of movement, with arrows indicating movement direction, touch-actuated means adjacent the arrows adapted for manual actuation to cause movement of the cylinders in the direction of the arrow adjacent the selected touch actuation means; and

calibrating the movement amount with respect to the manual actuation activity.

21. A process for providing color register for a multi-unit printing press, comprising the steps of:

providing a plurality of motors for moving the printing cylinders of the press;

coupling a remote console to the motors for controlling the operation of the motors and hence the correction size;

providing, on said remote console, touch-actuated means adapted for manual actuation to cause movement of the cylinders for a selected correction)

calibrating the motor movement with respect to the manual actuation activity, said calibration step comprising providing an alternating current to said motors for a time interval that is calibrated with the desired printing cylinder movement.

22. A ,process according to Claim 21, wherein the step of providing the alternating current comprises the providing of a number of alternating current cycles that are calibrated with the desired printing cylinder movement, with the laternating current cycles to the motors commencing with the zero crossing of an alternating current cycle.

23. A process according to Claim 21, including th step of centering each cylinder for subsequent operation, the centering step comprising th steps of first bringing the cylinder to a predetermined limit position and thereafter powering the motor contr lling the cylinder in the reverse direction for a predetermined time period.

24. A process for controlling th color register of

a plurality of multi-unit printing presses, comprising the steps f:

pr viding a plurality of motors for moving the printing cylinders of each of the presses;

pr viding a plurality of remote consoles, ach of which is applicable to control the printing cylinders of a different press;

coupling each of said remote consoles to one of the printing presses;

providing at least one of said remote consoles with touch-actuated means adapted for manual actuation to cause movement of the cylinders for a selected correction)

providing a plurality of communication lines interconnecting said remote consoles; and

providing an isolation interface for electrically isolating the consoles except when communication signals are transmitted from console to console.

25. A process according to Claim 24, wherein said motors are synchronous motors and including the step of providing an alternating current to the synchronous motors for a time interval that is calibrated with respect to said touch-actuated means.

26. A process according to Claim 20, including the step of providing the graphic representation with a representation of printing press units and including means for selecting the unit to be operated and means for selecting the desired quantity of printing cylinder movement for a selected printing cylinder of a selected unit.

27. A process for controlling color register on multi-unit printing presses, comprising the steps of:

providing a plurality of motors for moving the printing cylinders of the press;

coupling to said motors a remote console for controlling the operation of the motors and hence controlling movement of the printing cylinders;

providing, on said remote console, touch-actuated means for entering digital correction values and for selecting the printing cylinders to be moved;

entering a digital correction value by touching selected numbers on said touch-actuated means; and

selecting a printing cylinder to be moved by actuating a selected portion of said touch-actuated means adjacent to the graphic representation of the printing cylinder to be moved, whereby the selected printing cylinder will be moved the entered digital correction value amount.

28. A process according to Claim 27, wherein said touch-actuated means comprises membrane means overlying pushbutton switches.

29. A process for detecting a stall condition of an AC synchronous motor which comprises the steps of:

providing a phase shift capacitor network across the motor windings;

providing a voltage across ne of th motor windings; and

sensing the opposite phase voltage of g nerated mot r nergy whereby a stall is detected when th opposite phase voltage drops below a predetermined amount.

Printed in the UK for HMSO, D8818935, 6/86, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.